

EMC TEST REPORT



NVLAP Lab Code 200033-0

Standard(s):

47 CFR FCC Parts 15.247
RSS 247, Issue 3, 2023

FCC ID: DGFPD225B
IC: 458A-PSD225B

Product: 3M™ Advanced Electronics Gateway

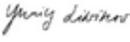
Model (HVIN): 70-0020-1020-8

Company Name:
3M Company

Address:
Fire & SCBA Solutions
4320 Goldmine Road, Monroe, NC 28110

Report Number: HRE202105206-2
Report Issue Date: April 1, 2024

Report Prepared by:

Signature: 
Yuriy Litvinov
Lead EMC Engineer

Tested by:
3M Hardgoods Regulatory Engineering Laboratory
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1.0 Test Summary

Based on the results of our investigation, we have concluded the product tested **comply** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

	Requirement – Test	Test Description	Result	Comments
4.1	FCC Part 15.247(a)(2)/ RSS-247(5.2(a))/RSS-Gen (6.7)	DTS Bandwidth	pass	
4.2	FCC Part 15.247(b)(3)/ RSS-247(5.4(d))	Maximum Peak Conducted Output Power	pass	
4.3	FCC Part 15.247(e)/ RSS-247(5.2(b))	Maximum Power Spectral Density level	pass	
4.4	FCC Part 15.209 RSS-Gen, 8.9	Radiated Emissions in restricted band	pass	
4.5	FCC Part 15.247(d)/ RSS-247(5.5)	Radiated Emissions in non-restricted band	pass	
4.6	FCC Part 15.247(d)(1)/ RSS-247(5.5)	DTS Band-edge Emissions Measurements	pass	
4.7	FCC Part 15.207/ RSS-Gen (8.8)	Conducted Emissions	pass	

Note:	
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1.1 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements. The measurement uncertainty figures were calculated and correspond to a coverage factor of k=2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Radiated emissions 30MHz to 1000MHz	4.9 dB
Radiated emissions 1GHz to 18GHz	4.6 dB
Conducted emissions 150KHz to 30MHz (AMN)	2.7 dB
Conducted emissions 150KHz to 30MHz (AAN)	1.92 dB
RF frequency	$\pm 3 \times 10^{-8}$
RF power, conducted	1.4 dB
RF Power Spectral Density	0.96 dB

1.2 Test Facility

Test Facility Accreditations:	ISO/IEC 17025:2017, NVLAP LAB CODE: 200033-0
	FCC US5320
	ISED Canada CAB identifier: US0012

2.0 Equipment Description

2.1	Equipment Under Test		
Description:	The Valor Gateway is a device used to "connect" a handheld Toughbook tablet or computer to SCBA (a self-contained breathing apparatus) telemetry systems worn by firefighters inside a fire scene. It contains LoRa 915MHz, Bluetooth (Low Energy) 2.4GHz and RFID 13.56MHz transmitters.		
Model(s):	70-0020-1020-8		
Serial number:	N/A		
3M Division:	Personal Safety		
Modifications and Special Measures:	none		
Frequency Range:	913-923 MHz		
Channel No.:	20		
Modulation Type:	GFSK		
FCC Classification:	Digital Transmission System (DTS)		
RF Conducted Output Power:	91.2mW (19.6 dBm)		
Antenna Type and Antenna Assembly Gain:	<input checked="" type="checkbox"/> External	<input type="checkbox"/> Monopole Antenna	<input checked="" type="checkbox"/> Dedicated
	<input checked="" type="checkbox"/> -2dBi	<input checked="" type="checkbox"/> Declared by the Manufacturer	<input type="checkbox"/> Measured
Test Deviations or Exclusions	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
Rated Power:	Voltage:	<input type="checkbox"/> 120VAC	<input type="checkbox"/> 230VAC
	Phase:	<input type="checkbox"/> 1ph	<input type="checkbox"/> 3ph
	Frequency:	<input type="checkbox"/> 50Hz	<input type="checkbox"/> 60Hz
	Current:	0.5 Amp.	
Test Dates:	08/16/2021-03/25/2024		
Received Date:	08/16/2021		
Received Conditions:	<input type="checkbox"/> Poor	<input checked="" type="checkbox"/> Good	
	<input checked="" type="checkbox"/> Prototype	<input type="checkbox"/> Production	

3.0 EUT Configuration

3.1 System Configuration

No.	Product Type	Manufacturer	Model	Comments
1	Valor Gateway	3M	Valor 225 Gateway	
2	USB Power Supply	Samsung	ETA-U90AWS	Support Equipment

3.2 Input/Output Ports of EUT

No.	Description	Type	Comments
1	DC Power	USB-C	
2			

3.3 Cables

No.	Description	Type	Length	Shielding	Comments
1	USB-C	USB 2.0	1m	Yes	
2					

3.4 Measurement Arrangements of EUT

	Intended Operational Arrangement(s)	Comments
<input checked="" type="checkbox"/>	Table-top only	
<input type="checkbox"/>	Floor-standing only	
<input type="checkbox"/>	Floor-standing or table-top	
<input type="checkbox"/>	Other	

3.5 Primary function(s) of EUT

No.	List of Essential Functions
1	Transferring of various data via LoRa radio to SCBA telemetry systems.
2	

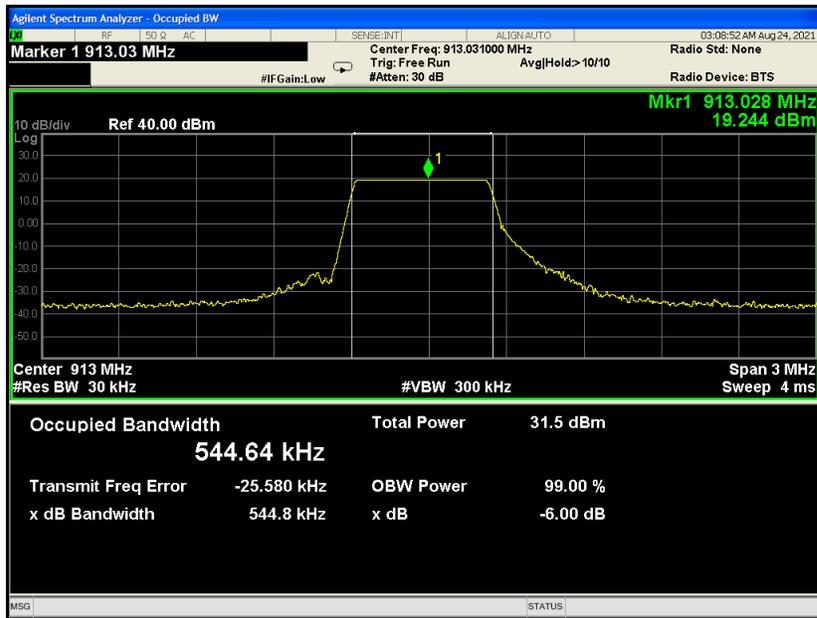
3.6 Exercising of EUT and Interfaces

No.	Mode of Operation
1	Transmitting at lowest 913MHz and highest 923MHz channels of operation with unmodulated CW carrier
2	Continues transmission of modulated signal at lowest and highest channels with a single channel BW >500KHz using SF (spreading factor) 11.
3	Device programming using YAT v 2.4.1 (Yet Another Terminal) software for continues transmission of modulated carrier at maximum rated RF output power and Duty Cycle.

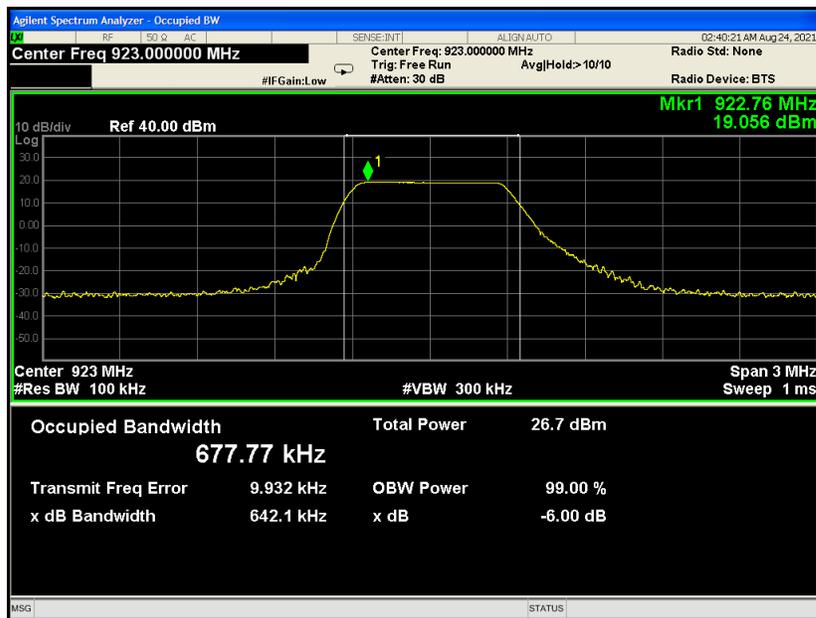
4.0 Test Conditions and Results

4.1	DTS Bandwidth		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.8.2 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point	
		<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 913-923 MHz	RBW = 100KHz VBW ≥ 3 x RBW	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>	Date: 08/23/2021	

Frequency (MHz)	Data Rate	99% dB Bandwidth (KHz)	6 dB Bandwidth (KHz)	6dB OBW Limit (KHz)	Results
913	2 Kbps	544.6	544.8	> 500	pass
923	2 Kbps	677.8	642.1	> 500	pass



OBW – Low Channel



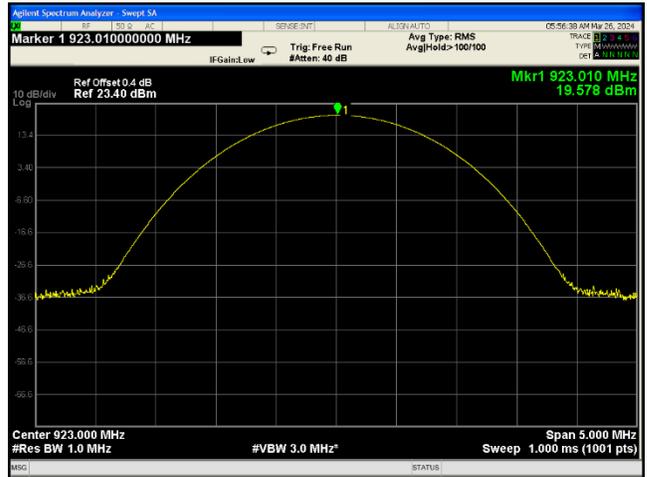
OBW – High Channel

4.2	Maximum Output Power		
Method:	Measurements was performed with CW carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.9 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point	
Frequency Range:	<input checked="" type="checkbox"/> 913-923 MHz	<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated at 3 meters	
Antenna Gain:	-2.0dBi	Maximum Conducted RF Power:	
Limit:	30 dBm	19.6 dBm	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>	Date: 03/25/2024	

Note:	EIRP (dBm) = Conducted Power (dBm) +Antenna Gain (dBi)= 19.6-2.0=17.6dBm
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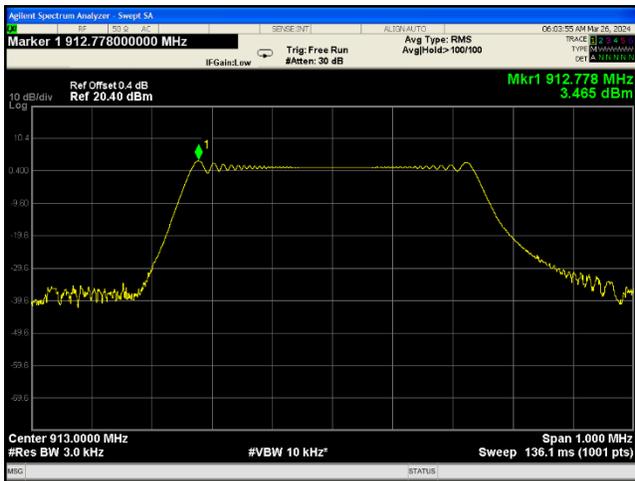


Low Channel

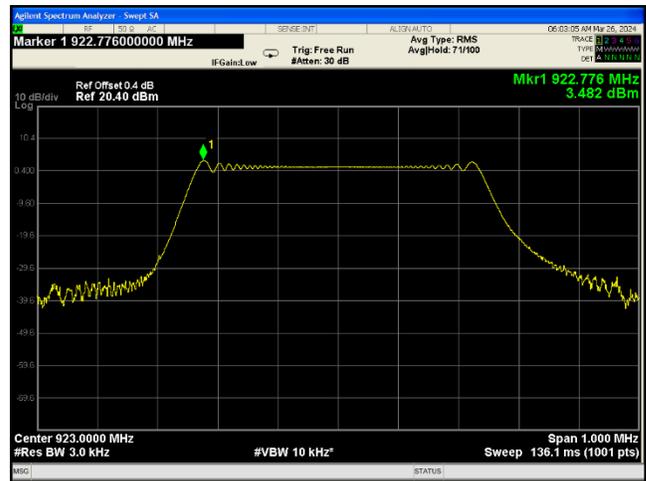


High Channel

4.3	Maximum Power Spectral Density level		
Method:	Measurements was performed with modulated carrier at the highest power level at which the transmitter is intended to operate. The analyzer offset was adjusted to compensate for the attenuator and other losses.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.10.2 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point	
		<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 913-923 MHz		PSD Results
PSD Limit:	8 dBm in any 3KHz band		3.5dBm
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>		Date: 08/23/2021



PSD Low Channel



PSD High Channel

4.4	Radiated Emissions in restricted band
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Method:	Measurements were made in a 3-meter semi-anechoic chamber that complies to CISPR 16/ANSI C63.4 standards. EUT was rotated through three orthogonal axes to determine which attitude (orientation) and arrangement produces the highest emission relative to the limit; the attitude and device arrangement that produces the highest emission relative to the limit was used in making final radiated emission measurements. Spurious Radiated emissions measurements were performed with external preamp and a high pass filter. Final measurements were then performed by rotating the EUT 360° and adjusting the receive antenna height from 1 to 4 m. All frequencies were investigated in both horizontal and vertical antenna polarity, where applicable.
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Test Verification: <input checked="" type="checkbox"/>	Laboratory Ambient Temperature:	23°C
	Relative Humidity:	55%
	Atmospheric Pressure:	1011 mbars

Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.12.1	Measurement Distance
	<input checked="" type="checkbox"/> FCC Part 15.205/15.209/RSS Gen (8.9)	
	<input checked="" type="checkbox"/> KDB 558074	<input checked="" type="checkbox"/> 3 Meters <input type="checkbox"/>

Frequency Range:	<input checked="" type="checkbox"/> 30 MHz to 1 GHz
	<input checked="" type="checkbox"/> 1 GHz to 10 GHz

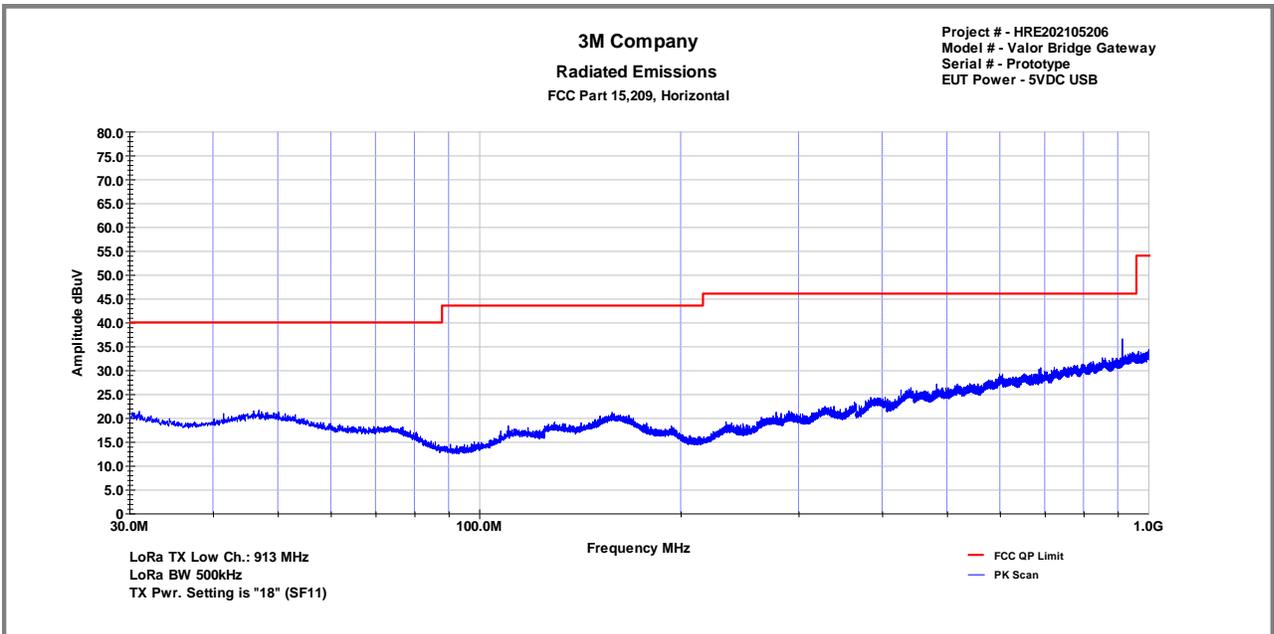
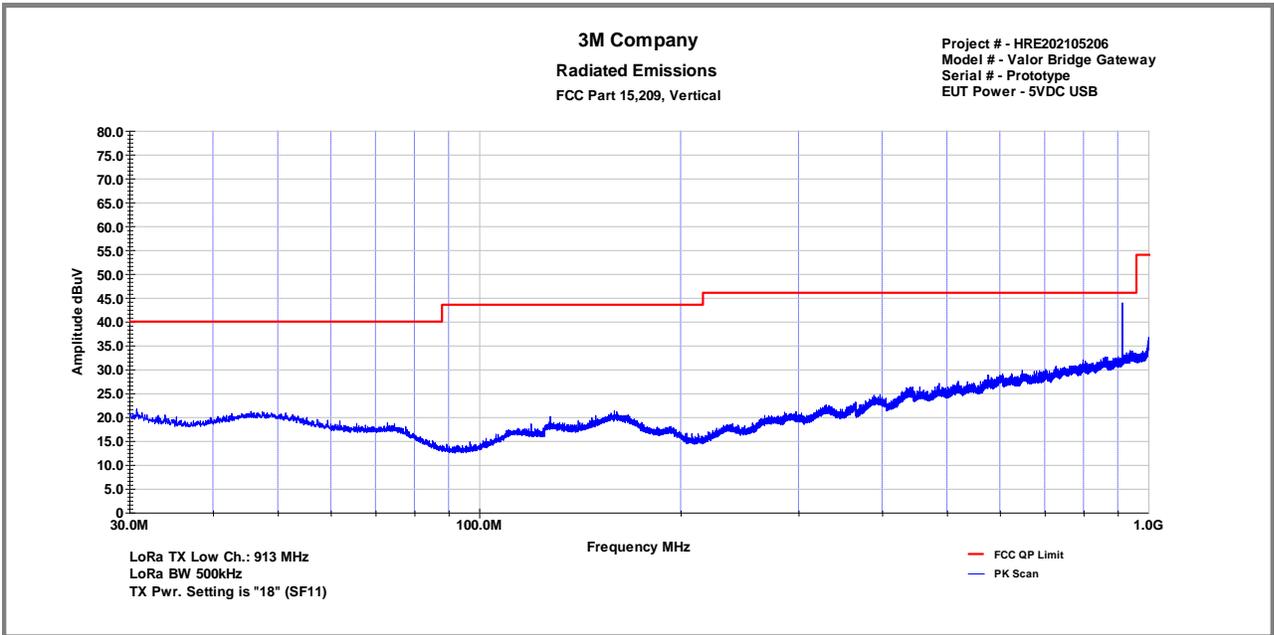
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC
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Test Personnel:	Keith Schwartz <i>KS</i>	Date: 08/19/2021
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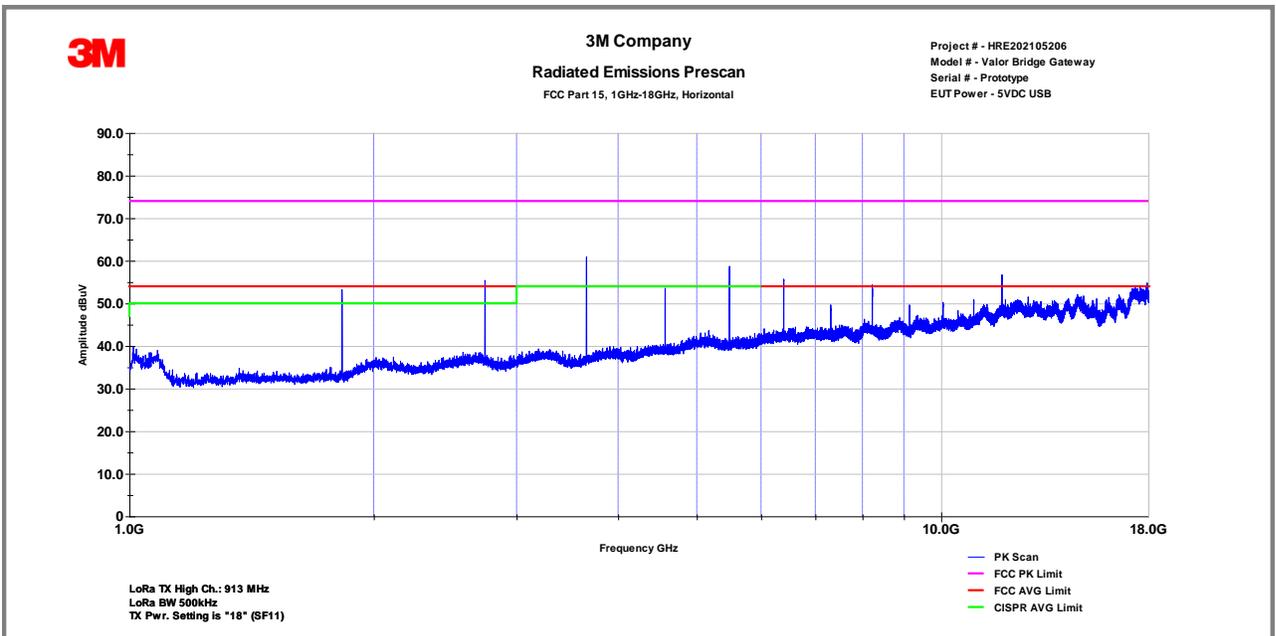
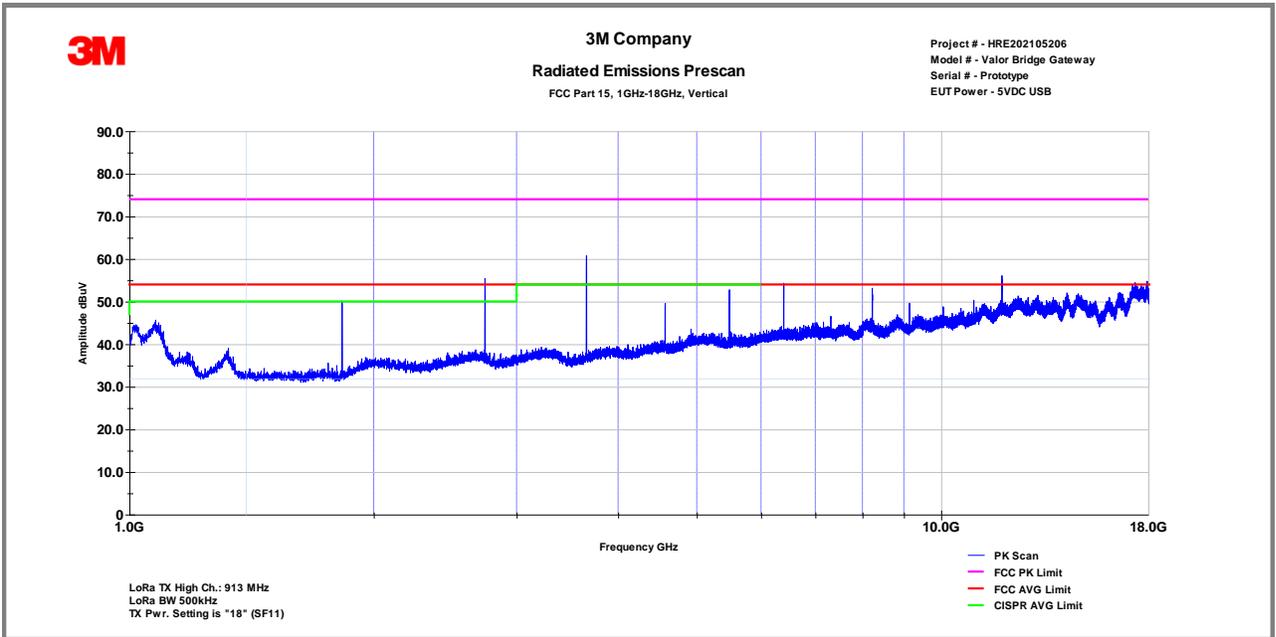
Limits –15.209 and RSS Gen					
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Frequency (MHz)	Limit dB (µV/m)			Distance	Results
	Quasi-Peak	Average	Peak		
0.009-0.490		2400/F(KHz)		300	N/A
0.490-1.705	24000/F(KHz)			30	N/A
1.705-30	30			30	N/A
30 to 88	40			3	pass
88 to 216	43.5			3	pass
216 to 960	46			3	pass
Above 960		54	74	3	pass

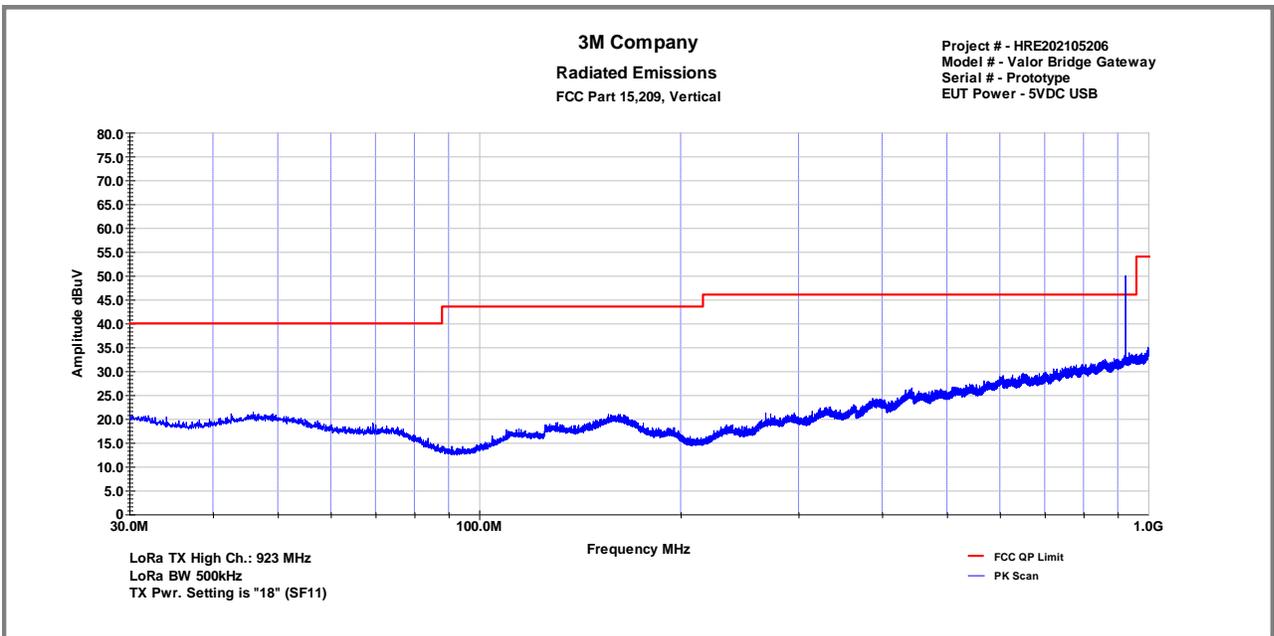
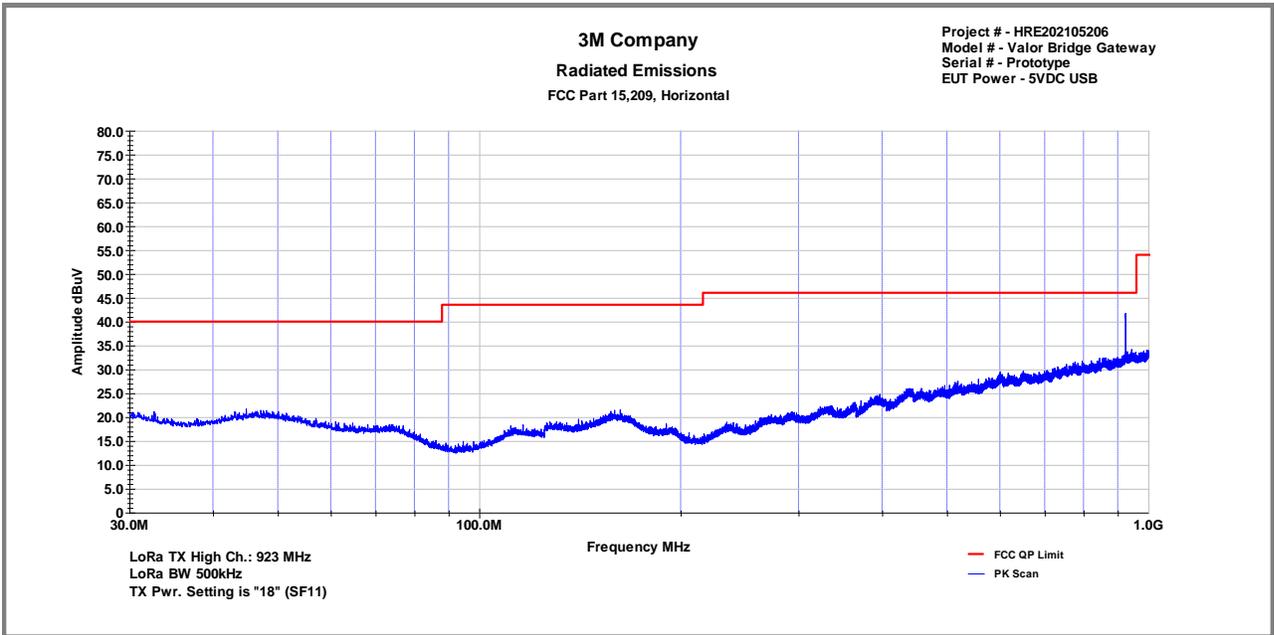
Modifications:	
Note:	The lower limit applies at the transition frequency. An inverse proportionality factor of 20 dB per decade has been used to normalize the measured data to the specified distance for determining compliance For emission in the restricted bands, the limit of 15.209 was used.



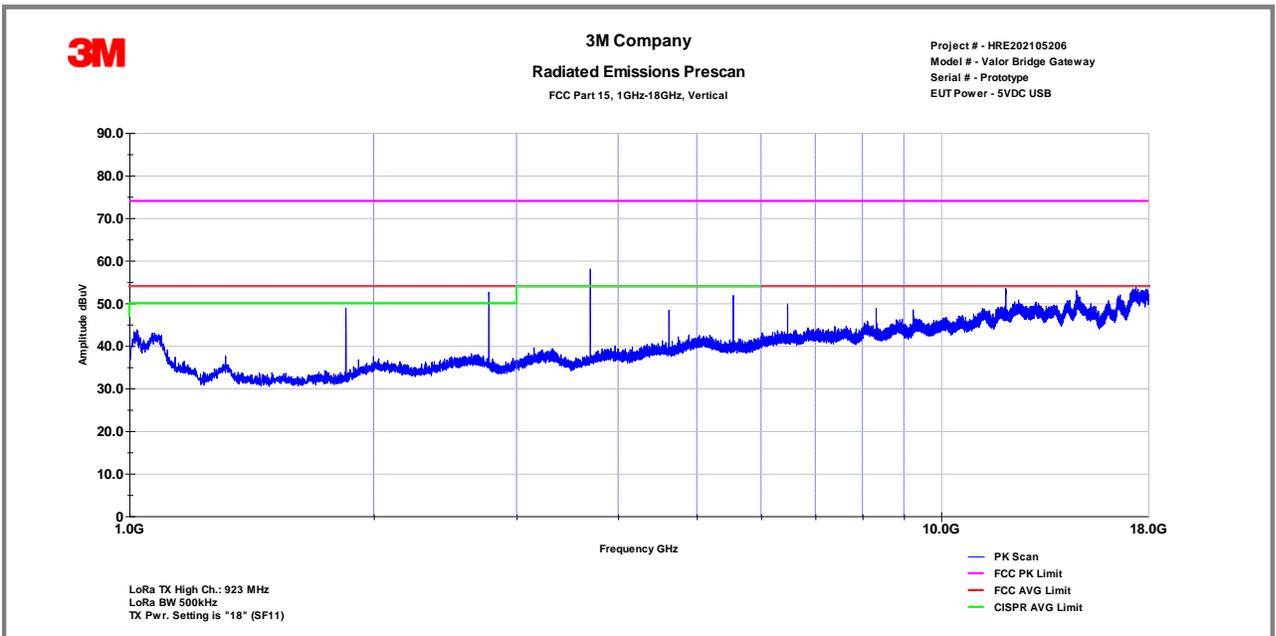
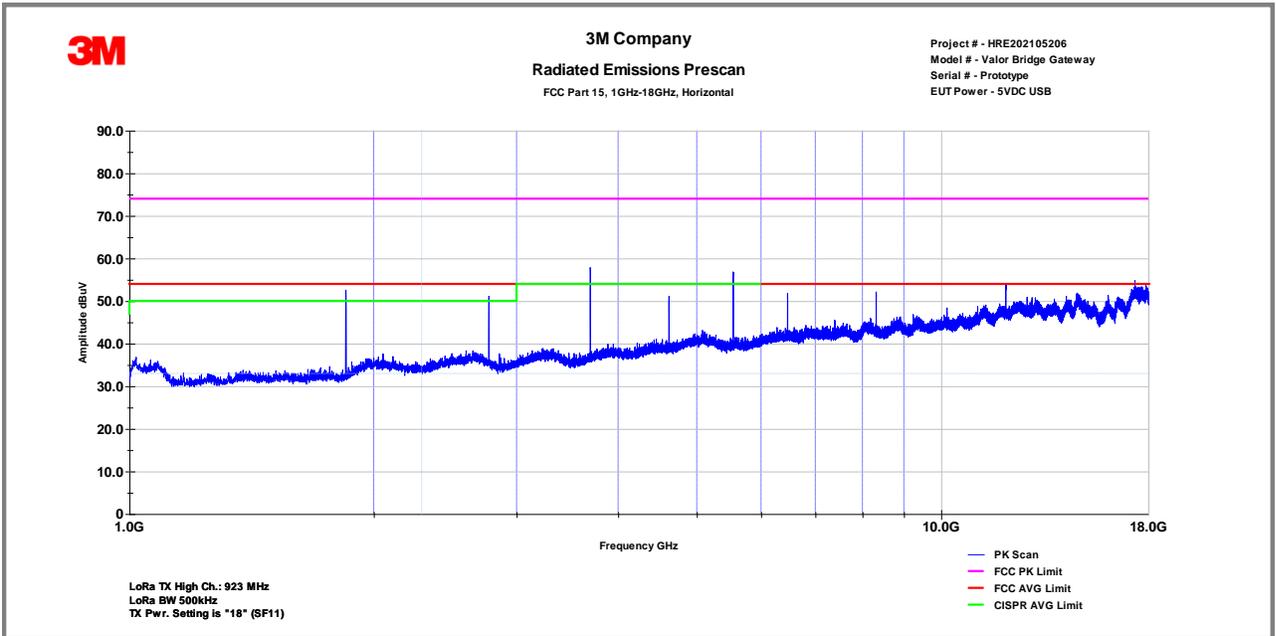
FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



FCC Part 15.209 Radiated Emissions in restricted band – Low Channel



FCC Part 15.209 Radiated Emissions in restricted band – High Channel



FCC Part 15.209 Radiated Emissions in restricted band – High Channel

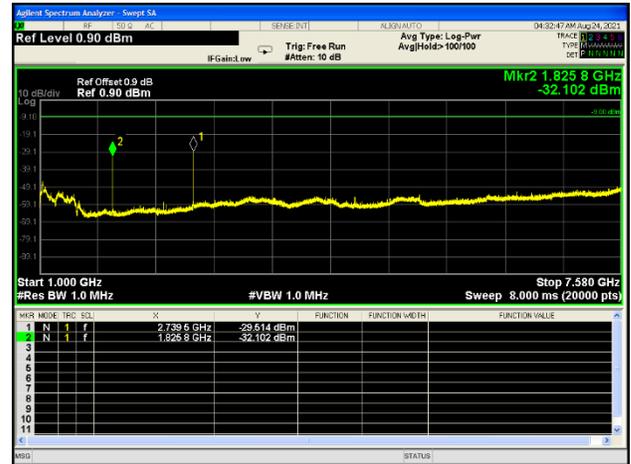
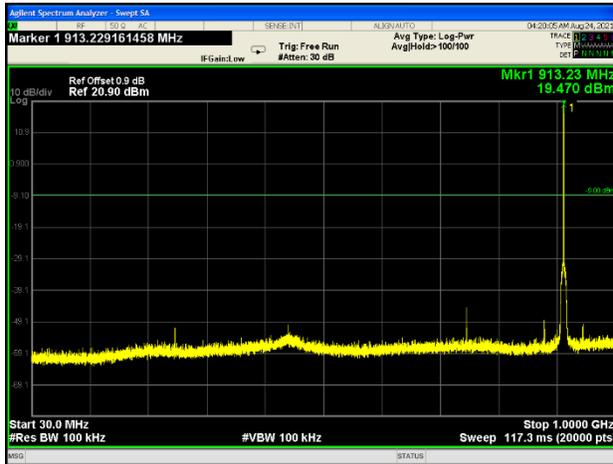
Tables - Radiated Emissions in restricted band

Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m	AVE Limit dBµV/m	PK Margin dB	AVG Margin dB
V	2739.00	66.46	59.1	-12.40	54.06	46.72	74.00	54.00	-19.94	-7.28
H	2739.00	67.70	57.5	-12.40	55.30	45.08	74.00	54.00	-18.70	-8.92
V	3652.00	72.53	64.8	-11.24	61.29	53.53	74.00	54.00	-12.71	-0.47
H	3652.00	72.74	62.3	-11.24	61.50	51.09	74.00	54.00	-12.50	-2.91
V	5478.00	58.86	46.72	-5.20	53.66	41.52	74.00	54.00	-20.34	-12.48
H	5478.00	60.46	51.48	-5.20	55.26	46.28	74.00	54.00	-18.74	-7.72
V	6391.00	58.48	46.81	-3.56	54.92	43.25	74.00	54.00	-19.08	-10.75
H	6391.00	60.12	48.74	-3.56	56.56	45.18	74.00	54.00	-17.44	-8.82
Notes:		Net Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))								
		Low Channel								

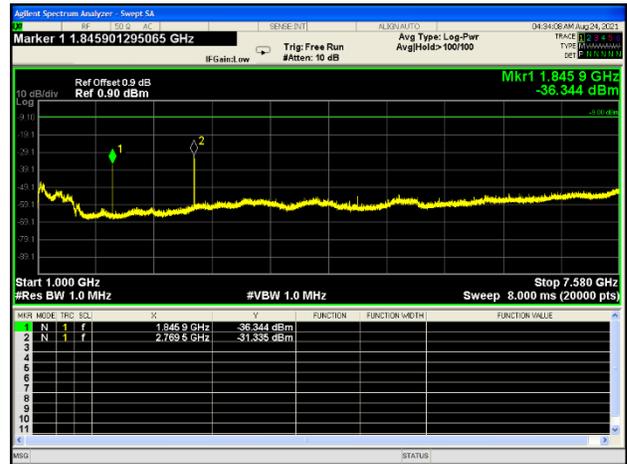
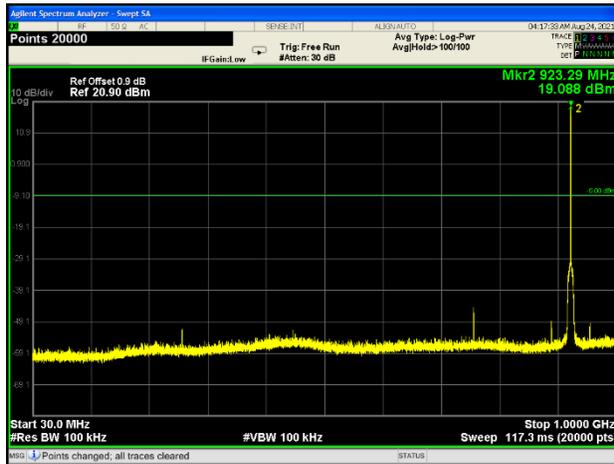
Pol	Frequency (MHz)	Peak dBµV/m	AVG dBµV/m	Total CF dB	Net Peak dBµV/m	Net AVE dBµV/m	PK Limit dBµV/m	AVE Limit dBµV/m	PK Margin dB	AVG Margin dB
V	1846.00	66.43	63.40	-16.60	49.83	46.80	74.00	54.00	-24.17	-7.20
H	1846.00	66.78	63.40	-16.60	50.18	46.80	74.00	54.00	-23.82	-7.20
V	2768.00	65.69	60.94	-12.40	53.29	48.54	74.00	54.00	-20.71	-5.46
H	2768.00	64.00	58.80	-12.40	51.60	46.40	74.00	54.00	-22.40	-7.60
V	3692.00	64.64	57.10	-10.80	53.84	46.30	74.00	54.00	-20.16	-7.70
H	3692.00	67.87	60.91	-10.80	57.07	50.11	74.00	54.00	-16.93	-3.89
V	8308.40	53.00	39.90	-1.70	51.30	38.20	74.00	54.00	-22.70	-15.80
H	8308.40	55.13	42.10	-1.70	53.43	40.40	74.00	54.00	-20.57	-13.60
Notes:		Net AVG VBW>1/T=2KHz Reading (dBuV) = Reading (dBµV) + (Antenna with amp CF(dB)+Cable CF(dB))								
		High Channel								

4.5	Radiated Emissions in non-restricted band		
Method:	The measurements were made with transmitter set to transmit continuously at low and high channels.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.11 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point	
Frequency Range:	<input checked="" type="checkbox"/> 913-923 MHz	<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
In-band power in 100KHz:	<input checked="" type="checkbox"/> 19.6dBm	Results:	
Limit:	<input checked="" type="checkbox"/> -10.4dBm (30dBc below in-band power)	>50dBc	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>	Date: 08/23/2021	

Note:	No spurious emissions above floor noise detected from 7.5GHz.
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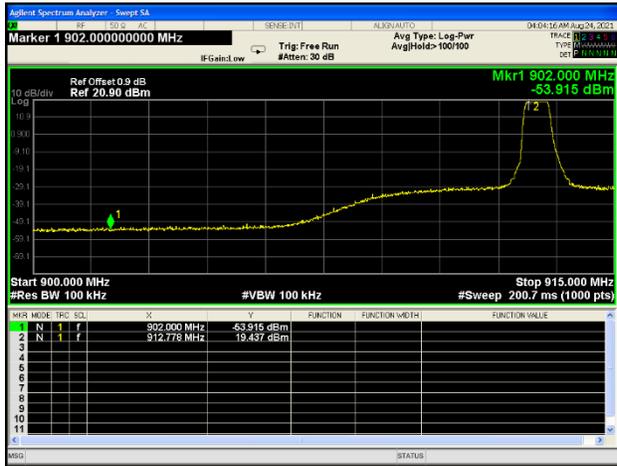
Conducted Spurious - Low Channel



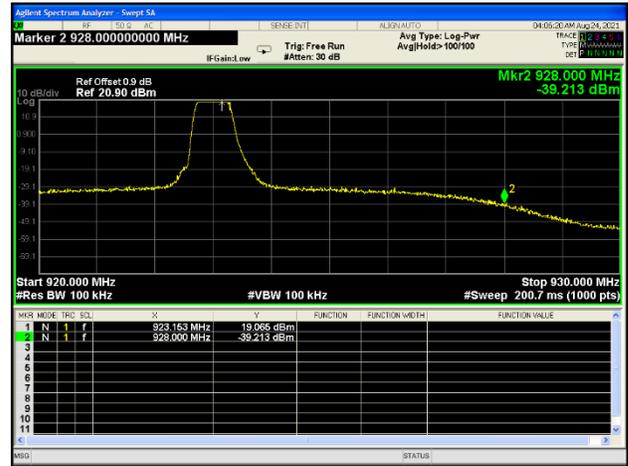
Conducted Spurious - High Channel

4.6	Band-Edge Compliance		
Method:	The measurements were made with transmitter set to transmit continuously with modulated signal at low and high channels.		
	Laboratory Ambient Temperature:	23°C	
	Relative Humidity:	48%	
	Atmospheric Pressure:	1011 mbars	
Reference Standard(s):	<input checked="" type="checkbox"/> ANSI C63.10:2020, Section 11.13.2 <input checked="" type="checkbox"/> FCC Part 15.247/RSS 247 <input checked="" type="checkbox"/> KDB 558074	Measurement Point	
		<input checked="" type="checkbox"/> Conducted <input type="checkbox"/> Radiated	
Frequency Range:	<input checked="" type="checkbox"/> 913-923 MHz	Results	
Limit:	<input checked="" type="checkbox"/> >30dBc	Low Ch., 913 MHz > 70dBc High Ch., 923 MHz > 60dBc	
Nominal Voltage:	<input type="checkbox"/> 120VAC <input checked="" type="checkbox"/> 5VDC		
Test Personnel:	Yuriy Litvinov <i>Yuriy Litvinov</i>	Date: 08/23/2021	

Note:	
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Band Edge - Low Channel



Band Edge - High Channel

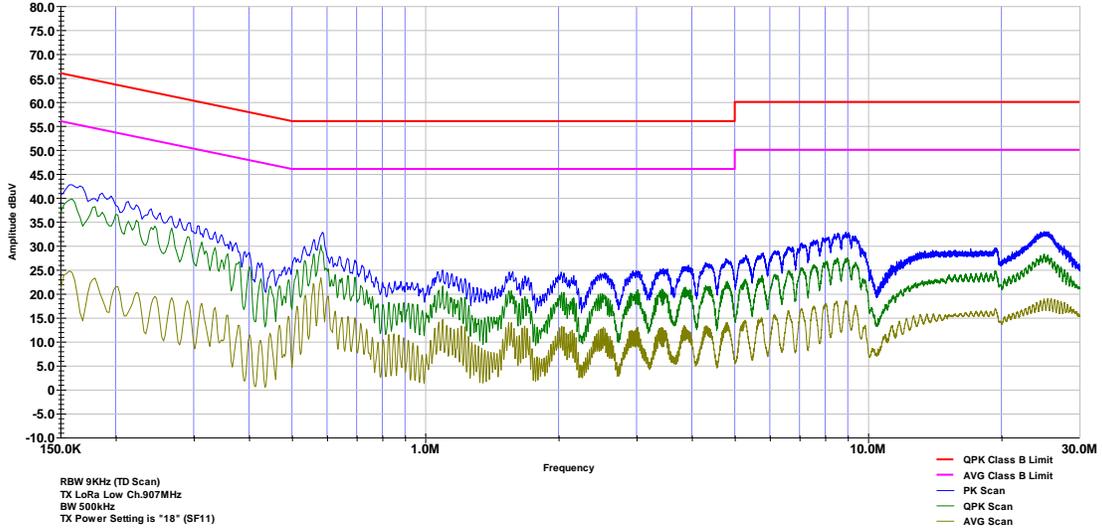
4.7	Conducted Emissions Data			
Method:	The AMN was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane. This distance was between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the AMN. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.			
	All power was connected to the system through Artificial Mains Network (AMN). All tested telecommunications lines were connected to an Asymmetric Artificial Network (AAN) and conducted voltage measurements on telecommunications lines were made at the output of the ISN. Where an AAN was not appropriate or available measurements were made using a Capacitive Voltage Probe.			
Test Verification: <input checked="" type="checkbox"/>	Laboratory Ambient Temperature:	23°C		
	Relative Humidity:	48%		
	Atmospheric Pressure:	1011 mbars		
Reference Standard(s):	<input checked="" type="checkbox"/> RSS GEN/FCC 15.207 <input checked="" type="checkbox"/> ANSI C63.4:2014 <input type="checkbox"/> ANSI C63.10:2020		Measurement Point	
			<input checked="" type="checkbox"/> Mains <input type="checkbox"/> Telecommunication ports <input type="checkbox"/>	
Nominal Voltage:	<input checked="" type="checkbox"/> 120VAC <input type="checkbox"/> 230VAC <input checked="" type="checkbox"/> 5VDC			
Test Personnel:	Keith Schwartz <i>KS</i>		Date: 08/18/2021	
Limits – Part 15.209/RSS Gen – AC Mains				
Frequency (MHz)	Limit dB (µV)			
	Quasi-Peak	Average	Result	Comments
0.15 to 0.50	66 to 56	56 to 46	pass	Time Domain Scan
0.50 to 5	56	46	pass	Time Domain Scan
5 to 30	60	50	pass	Time Domain Scan

Modifications:	
Note:	



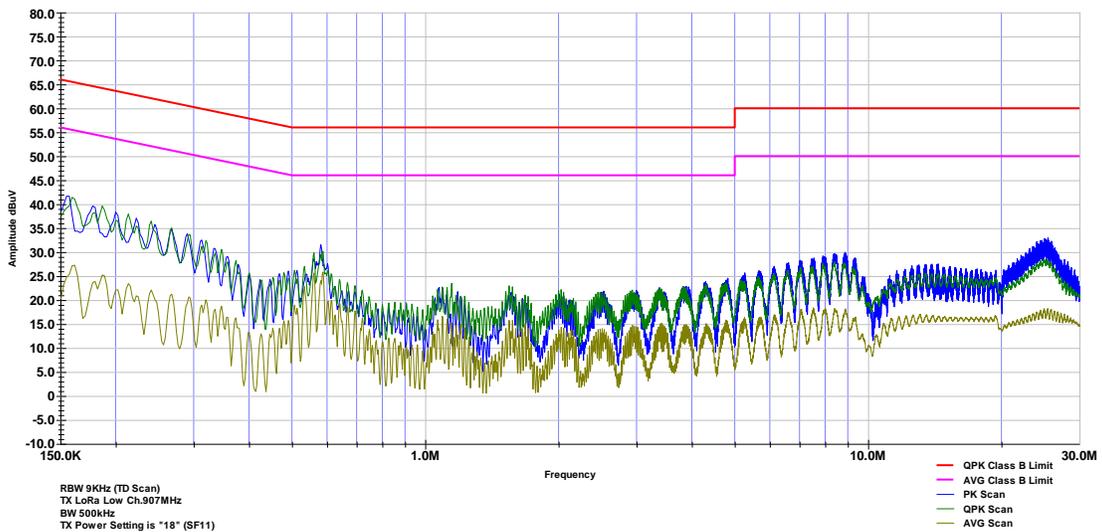
3M Company
Conducted Emissions
CISPR 32_FCC Part 15, Class B, Line 2

Project # - HRE202105206
Model # - Valor Bridge Gateway
Serial # - Prototype
EUT Power - 120VAC/60Hz to 5VDC USB adaptor



3M Company
Conducted Emissions
CISPR 32_FCC Part 15, Class B, Line 1

Project # - HRE202105206
Model # - Valor Bridge Gateway
Serial # - Prototype
EUT Power - 120VAC/60Hz to 5VDC USB adaptor



5.0		Test Equipment			
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Last Cal. Date	Check
Biconilog Antenna	Schwarzbeck	VULB 9168	9168-1070	10/20/2020	<input checked="" type="checkbox"/>
Horn Antenna	A.H. Systems	SAS 571	1010	10/20/2020	<input checked="" type="checkbox"/>
Loop Antenna	A.H. Systems	EHA-51B	1213E	10/20/2020	<input type="checkbox"/>
EMI Receiver	Rohde & Schwarz	ESW26	101412	10/20/2020	<input checked="" type="checkbox"/>
Signal Analyzer	Agilent	N9000A	MY53031040	10/20/2020	<input checked="" type="checkbox"/>
EMI Receiver	Agilent	E4448A	1530975	10/20/2020	<input checked="" type="checkbox"/>
LISN	TESEQ	NNB51	1130	10/20/2020	<input checked="" type="checkbox"/>
Coaxial Cable	Insulated Wire	2803	CBL2039	10/20/2020	<input checked="" type="checkbox"/>
EMC Software	ETS-Lindgren	TILE 7		N/A	<input checked="" type="checkbox"/>
Equipment Calibration Interval:			<input checked="" type="checkbox"/> 12 months		<input type="checkbox"/> 24 months

6.0		Report revision history		
Revision Level	Date	Report Number	Notes	
0	04/01/2024	HRE202105206-2	Original Issue	